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Latent heat body with pore structure and method for its production

a Field And Background of The Invention

The invention relates to a latent heat body with paraffin-based latent heat storage material held in a carrier material which has holding spaces.

A porous foam material as carrier material is known from German utility model 84 08 966. However, with this foam material it is impossible to achieve the structural strength which is desired even in the heated state of the latent heat storage material. Moreover, the porous foam material cannot readily be impregnated with the latent heat storage material, but rather special measures, such as squeezing, have to be taken.

A latent heat body in which furthermore the carrier material is assembled from individual carrier material elements, for example by adhesive bonding, capillary-like holding spaces for the latent heat storage material being formed at any rate between the carrier material elements, is also known from PCT/EP 98/01956, which is not a prior publication. The content of this document is hereby also incorporated in its entirety in the disclosure of the present application, partly with a view to including features of this document in claims of the present application.

Working on the basis of the abovementioned German utility model 84 08 966, the invention is based on the object of providing a latent heat body which, while being simple to produce, is highly effective, i.e. has a high heat storage capacity, and which at the same time has sufficient structural strength even in the heated state and in particular satisfies high static demands. Furthermore, it is desired for the carrier material to as far as possible automatically fill itself with or suck up the latent heat storage material

and to have a high retention capacity for latent heat storage material.

Summary of The Invention

This object is initially and substantially achieved wherein it is ~~with the subject matter of claim 1, in which it is~~ provided that capillary holding spaces for the latent heat storage material are formed inside the carrier material and that the carrier material contains a mineral substance with an open capillary pore structure. For a mineral substance of this type, consideration is given to an absorbent solid structure, preferably comprising a gypsum material or a clay material or calcareous sandstone or siliceous earth (dolomite earth) or any desired combinations of these materials. Preferred starting products are untreated gypsum plates, gypsum granules, siliceous earth granules (dolomite earth). In addition to being universally available and being inexpensive raw materials, these products satisfy high static demands, fire prevention requirements and have a relatively high thermal conductivity. Compared with latent heat bodies having a carrier material consisting of fibers, latent heat bodies with solid structures of this type generally have a lower proportion by mass of latent heat storage material, which is nevertheless sufficient for numerous uses, paraffin preferably being used as latent heat storage material, although stearin, fat or similar substances can also be used. Compared with latent heat bodies with a higher proportion by mass of latent heat storage material, the result for the latent heat body according to the invention is a cost benefit, in particular in view of the low raw material costs of the carrier material. Nevertheless, it is also possible, in a latent heat body according to the invention, for the carrier material, in addition to a mineral substance, also to contain fiber elements, which are preferably disposed in distributed manner in the carrier material. The fiber elements may in

principle consist of organic and/or inorganic materials and may be selected in particular from the materials mentioned in PCT/EP 98/01956. In this context, examples mentioned are organic materials, such as plastics, cellulose, or wood, ceramic, mineral wool, plastics, cotton or wool. Fiber elements made from plastics preferably have base materials such as polyester, polyamide, polyurethane, polyacrylonitrile or polyolefins. In general terms, it is also possible to use fiber elements made from various materials with very different lengths and very different diameters in any desired combinations. A carrier material which, in addition to a mineral substance with an open capillary pore structure, i.e. an absorbent solid structure, also contains fiber elements can, depending on the selected proportions by mass, have properties which are optimized for a particular usage. For example, adding fiber structures generally effects an increased storage capacity for latent heat storage material and a reduction in the thermal conductivity. The latter simultaneously leads to an increase in the storage emission time, i.e. to the heat transfer being slowed, which in many uses offers advantages. Furthermore, the mineral substance with the open capillary pore structure and the fiber elements may also differ in further materials properties or features, such as for example the density, the heat storage capacity, the coloring and the like, so that controlled adaptation of the carrier material to the particular intended use is possible by suitable selection of corresponding quantitative proportions. Overall, it becomes clear that a combination of this type considerably increases the range of uses of carrier material.

It is particularly preferred for the latent heat storage material to be a paraffin or to be based on such a paraffin, as described in DE-A 43 07 065. The content of this prior publication is hereby

incorporated in its entirety into the disclosure of the present application, partly with a view to including features of this prior publication in claims of the present application. In a preferred embodiment, the proportion by mass of the latent heat storage material, based on the total mass of the latent heat body, is between 5 and 50%, preferably 25% or further preferably 40 to 50%. The open capillary pore structures, which on account of their capillary sucking action are also designated as "sucking structures", in an advantageous embodiment are formed in such a way that a preferably uniformly distributed residual air volume remains therein, which absorbs temperature-dependent changes in volume of the latent heat storage material of preferably at most 10% of the latent heat storage material volume. Temperature expansion of the abovementioned order of magnitude is associated with conventional maximum overheating compared with the melting temperature of the latent heat storage material of 30 to 40°K, so that, on account of these temperature-dependent volume changes being absorbed or compensated for by the residual air volumes, under these conditions there is no sweating of the latent heat storage material out of the carrier material. Nevertheless, the latent heat body according to the invention may be adapted to specific usages by a latent heat storage material with additives contained therein, such as preferably thickening agents and/or a proportion of mineral oils and polymers and/or others of the additives mentioned in PCT/EP 98/01956 and/or DE-A 43 07 065, in such a manner that even in the event of the melting or phase transition temperature being exceeded by more than the levels stated above there is no possibility of the latent heat storage material sweating out of the carrier material. As an alternative or in combination, the latent heat body can have a sheath, which preferably consists of a film/foil material, such as for example plastics film or aluminum

foil. In this context, consideration is given in particular to a sheath which is impermeable to latent heat storage material. However, for certain usages it may also be advantageous for the sheath to be formed with a controlled permeability for latent heat storage material, for example by introducing small pores into a film/foil material which is impermeable to latent heat storage material, leading to a desired "breathing activity" of the sheath. Breathing activity of this type may, for example, be advantageous when the latent heat body additionally contains a hygroscopic material, since the possibility then exists of withdrawing the moisture which has been bonded to the hygroscopic material from the environment of the latent heat body. In this context, the disclosure content of DE 198 36 048.7 is also completely incorporated in the present application, partly with a view to including features described therein in claims of the present application.

Consideration is initially given to the carrier material being formed in a latent heat body as a cohesive structure, i.e. to a cohesive body with capillary holding spaces for the latent heat storage material contained therein being formed from the mineral substance with the open capillary pore structure and the fiber elements which may additionally be contained therein. A carrier material which is formed from a mineral substance with an open capillary pore structure and from fiber elements can contain capillary holding spaces produced by the capillary pore structure alone and/or capillary holding spaces formed by fiber elements adjoining one another and/or capillary holding spaces formed by mineral substance in combination with fiber elements. In this case, in the context of the invention the term open capillary pore structure is understood as meaning a pore structure which, in terms of its openness, has connections

between the individual pores and between the pores which lie in the vicinity of the surface or edge and the surrounding environment and which in terms of its capillary action exercises an automatic sucking action on latent heat storage material. According to the invention, an open capillary pore structure is also obtained with a carrier material which, in addition to a mineral substance, also contains fiber elements. The pores or capillary holding spaces may in particular be formed in the manner of channels, including with a variable channel cross section, and/or may also contain spherical or similar cavities. However, additional further forms are also conceivable.

As an alternative to a cohesive structure of the carrier material, in an alternative embodiment of the latent heat body it is provided that the latter contains a number of latent heat part-bodies, a latent heat part-body containing a carrier material part-body and the latent heat storage material which is held in the capillary holding spaces contained therein and the residual air volume which is likewise present in the capillary holding spaces. The latent heat body according to the invention or the absorbent solid structures may, for example, be used in the form of plates, slabs, building blocks, granules or other forms for a wide range of tasks. For example, it is possible to use slabs or building blocks independently or in a structural assembly (walls). Further possible uses are a warming plate for foodstuffs, use in combination with floor heating and a transport container, which are dealt with in more detail in connection with the description of the figures.

The invention also relates to a method for producing a latent heat body with paraffin-based latent heat storage material held in a carrier material which has capillary holding spaces. Methods of the generic type

are known from PCT/EP 98/01956, which is not a prior publication, and DE 198 36 048.7, which is likewise not a prior publication. The invention is based on the object of providing a method with which the abovementioned latent heat body can be produced easily and inexpensively. According to the invention, to achieve the object it is provided that the latent heat storage material is liquefied, that the previously liquefied latent heat storage material is conducted to automatically sucking, capillary-like holding spaces of the carrier material, and that a carrier material which contains a mineral substance with an open, capillary pore structure is used. The carrier material or the mineral substance and the latent heat storage material may in this case preferably have one or more of the features described above in each case. In particular, it is possible for fiber elements, which may likewise have one or more of the features listed above in connection therewith, to be added to the mineral substance. It is preferred for the fiber elements to be uniformly distributed in the mineral substance. For this purpose it is possible, for example, starting from an initial state of the mineral substance, in which the latter is present in free-flowing, liquid or pasty form, for fiber elements to be stirred into the mineral substance until they have preferably adopted a uniform dispersion and, in further method steps, for initially liquefaction and then, by a thermal treatment (firing), for a desired absorbent solid structure, i.e. an open capillary pore structure, to be produced.

The liquefaction of the latent heat storage material can be carried out in a simple way by supplying thermal energy until the desired degree of liquefaction, up to possible complete liquefaction of the latent heat storage material, has been reached. If the previously liquefied latent heat storage material, in a further method step, is then conducted to the automatically

sucking, capillary-like holding spaces of the carrier material, the capillary sucking action of the open, capillary pore structure of the carrier material leads to an automatically occurring, ongoing uptake of the latent heat storage material in the capillary-like holding spaces of the carrier material being observed. Therefore, a substantial advantage of the method according to the invention is that mechanical action on the carrier material and the latent heat storage material for this purpose can be dispensed with altogether. Rather, the previously liquefied latent heat storage material is taken up in the carrier material even when the previously liquefied latent heat storage material is conducted at zero pressure to the automatically sucking, capillary-like holding spaces of the carrier material. In a preferred variant of the method according to the invention, the latent heat storage material is introduced into a container, in which it is liquefied up to a desired level by the supply of heat, whereupon the carrier material is immersed in the previously liquefied latent heat storage material. As a result of the immersion, the previously liquefied latent heat storage material is introduced to the automatically sucking capillary holding spaces of the carrier material, so that it is automatically taken up in these spaces by the capillary sucking action. In a further preferred refinement of the method, the temperature of the latent heat storage material, while it is being conducted to the automatically sucking, capillary-like holding spaces of the carrier material, is regulated by the controlled supply and/or dissipation of heat. By way of example, it is possible, when the carrier material is immersed in the previously liquefied latent heat storage material, to achieve further liquefaction or a further reduction in the viscosity of the latent heat storage material by controlled supply of heat and thus to promote the uptake into the capillary-like holding

spaces. On the other hand, it is also possible to bring about the opposite effect during the immersion, by dissipation of heat or by cooling the latent heat storage material, with the result that, for example after a suitably selected time duration of the immersion process, slowing or even, if required, termination of the uptake of further latent heat storage material can be realized. Furthermore, it is possible for additives which advantageously influence the flow characteristics of the latent heat storage material and/or which advantageously influence the crystal structure produced during cooling to be added to the latent heat storage material. By way of example, a thickening agent and/or a proportion of mineral oils and polymers may be added to the latent heat storage material. Furthermore, it is also possible to use additives as described in DE-A 43 07 065 and/or in PCT/EP 98/01956. Preferably, with the method according to the invention a mass or amount of the latent heat storage material which is between 5 and 50%, preferably 25% and further preferably 40 to 50%, of the total mass of the latent heat body is conducted to the holding spaces of the carrier material in order to be taken up. For example, if the specific amount of uptake in a carrier material per unit time is known for a selected latent heat storage material in a specific state of liquefaction, it is possible for the mass of latent heat storage material taken up into the holding spaces of the carrier material to be influenced in a controlled way by suitably selecting the duration of uptake. Once this duration has expired, it is then possible to terminate the uptake process by separating the latent heat storage material which still remains outside the carrier material from the carrier material, for example by removing the carrier material from an immersion bath of the previously liquefied latent heat storage material. In this context, it is also preferable for the latent heat body or the carrier

material, after removal from an immersion bath, initially to be drip-dried and then cooled to a desired temperature, for example to ambient temperature, in a further possible method step. With regard to the immersion method described above, it is additionally pointed out that introducing the previously liquefied latent heat storage material to the carrier material can also take place in other expedient ways, for example by dripping latent heat storage material into the carrier material or by applying, to the carrier material, a latent heat storage material layer thickness which is intended to be taken up and may be defined. In a further method step, it is possible for the latent heat body to be provided with a sheath, which may have one or more of the features described above in connection therewith.

There are numerous possible uses for the latent heat bodies according to the invention, on account of the advantageous properties explained above and their possible variations. They are employed, for example, in the form of slabs, building blocks or granules, on their own or in a structural assembly (walls). Further possible uses in the construction industry are storage walls, roofs or floor storage heating systems. In this context, the advantageous effect is achieved that, from building materials which are "light" in terms of the heat storage capacity, "heavy" building materials are obtained by the impregnation or by the uptake of latent heat storage material, without the layer thickness of these materials being changed. Furthermore, as emerges from the following description of preferred exemplary embodiments, numerous other uses of the latent heat body according to the invention are conceivable.

In this context, the invention also relates to a warming plate having a plate base body and having a formed receptacle for foodstuffs, in particular for

rice. According to the invention, it is provided that the plate base body contains a latent heat body with paraffin-based latent heat storage material which is held in a carrier material having holding spaces, capillary holding spaces for the latent heat storage material being formed inside the carrier material and the carrier material containing a mineral substance with an open capillary pore structure. Furthermore, it is possible for the latent heat body of the warming plate to have one or more of the features explained above in connection therewith. In a preferred configuration, it is provided that one or more receptacles for foodstuffs have in each case a recess which is integrated into a surface of the plate base body. The advantage of the warming plate according to the invention consists in an inexpensive and simple yet stable structure and in a highly effective heat storage action.

The invention also relates to floor heating, in particular electric floor heating, having a heating register disposed between a bare floor and a covering, according to the invention a latent heat body with paraffin-based latent heat storage material held in a carrier material which has holding spaces being provided, capillary holding spaces for the latent heat storage material being formed inside the carrier material and the carrier material containing a mineral substance with an open capillary pore structure. Furthermore, the latent heat body may have one or more of the features described above. In particular, it is possible for the latent heat body to be formed in the manner of a slab and to be disposed between the bare floor and the heating register. In a preferred embodiment, a thermal insulation layer, which may, for example, be a Styropor layer, is disposed on the top side of the bare floor. Furthermore, it is preferred for a first layer with a latent heat body which is

formed from latent heat part-bodies and may likewise have one or more of the features explained in connection with the latent heat body according to the invention to be disposed between the bare floor and the heating register. In particular, it is possible for the first layer described above to be disposed between the slab-like latent heat body and the heating register. In an expedient refinement of the floor heating, a second layer with a latent heat body which is formed from latent heat part-bodies and may likewise have one or more of the features as are described in connection with the latent heat body according to the invention is provided between the heating register and the covering. In particular, consideration is given to the latent heat part-bodies of the first and/or second layer being formed in the manner of granules. Furthermore, it is possible for a latent heat storage material with a phase transition temperature which is different compared with the latent heat storage material contained in the latent heat part-bodies of the second layer to be held in the latent heat part-bodies of the first layer. In particular, consideration is given to the phase transition temperature of the latent heat storage material of the first layer being higher than the phase transition temperature of the latent heat storage material of the second layer. The advantageous properties of the floor heating according to the invention include its high heat storage capacity and the associated uniform emission of heat to the room above it. Furthermore, on account of the structural property of the latent heat bodies contained therein, the floor heating satisfies high static demands.

The invention also relates to a transport container having an outer housing and an inner housing which is held therein spaced apart by a space. According to the invention, it is provided that a latent heat body is disposed in the space, with paraffin-based latent heat

storage material held in a carrier material which has holding spaces, capillary holding spaces for the latent heat storage material being formed inside the carrier material and the carrier material containing a mineral substance with an open capillary pore structure. The latent heat body may furthermore have one or more of the features explained above in connection therewith. In an expedient refinement, plate-like latent heat bodies are held preferably detachably or removably in the space, at least two latent heat bodies with different phase transition temperatures of the latent heat storage material respectively held therein being disposed adjacently in the direction perpendicular to the plate plane of the plate-like latent heat bodies.

The invention also relates to a latent heat body ~~according to the precharacterizing clause of claim 41~~. ~~According to this precharacterizing clause, it is a latent heat body~~ having a carrier material and paraffin-based latent heat storage material held therein in capillary holding spaces, the latent heat body containing a number of latent heat part-bodies and a latent heat part-body containing a carrier material part-body and latent heat storage material which is held therein in capillary holding spaces. A latent heat body of this type is known from WO 98/53264. To the extent that this document provides for a latent heat body to have a number of latent heat part-bodies, the latent heat part-bodies more or less loosely butt against one another by means of their outer surfaces, with air volumes possibly also being included between the latent heat part-bodies. Starting from this point, the further subject matter of the invention is based on the object of developing a latent heat body of the generic type in a manner which is advantageous for use.

This technical problem is initially and substantially solved wherein ~~solved by the characterizing features of claim 41, in~~

~~which~~ it is provided that the number of latent heat part-bodies together is surrounded by an embedding material, and that the carrier material contains wood fibers and/or cardboard and/or granulated siliceous earth and/or diatomaceous earth. Further materials which have capillary holding spaces which are suitable for the invention may also be correspondingly used, so that the latent heat storage material is in any event well taken up by the capillary sucking action of the holding spaces in the carrier material. Furthermore, it is preferable for a residual air volume which absorbs temperature-dependent changes in volume of the latent heat storage material of up to approximately 10% of the latent heat storage material volume to be present in the capillary holding spaces. As has already been described with regard to the first inventive subject of the present application, the carrier material may moreover contain fiber elements, preferably in a uniform distribution. It is also possible for the latent heat storage material to contain a thickening agent and/or a proportion of mineral oils and polymers.

It is likewise also possible in a latent heat body as described ~~in connection with claims 1 to 15~~ for the carrier material together with the latent heat storage material held therein in the capillary holding spaces to be surrounded, in terms of its outer contours, by an embedding material. The carrier material may in this case be formed to be cohesive or may be in the form of carrier material part-bodies, a carrier material part-body together with the latent heat storage material held therein and, if necessary, also residual air volumes held in the capillary holding spaces forming a latent heat part-body in the sense of the present application.

Where reference is made to an embedding material, this material may, for example, be silicone, in particular a

silicone rubber, resin, concrete, cement, gypsum, mortar or other materials of similar properties, mixtures or mixes of a plurality of these substances also being possible for use as embedding materials. The selection of the material or materials used as embedding material may preferably be carried out in such a manner that, adapting to the carrier material selected in the individual case, a total hardness or total rigidity of the latent heat body which is overall advantageous for the use of the latent heat body is established. It is also possible, by adapting in particular carrier material and embedding material, for the overall resilience, the overall density and further resultant properties, such as for example thermal conductivity, heat storage capacity and the like, to be influenced. The embedding or surrounding of the carrier material together with latent heat storage material contained therein in the embedding material is preferably carried out in the sense of mixing, encasing or even impregnation with the embedding material preferably occurring, which overall leads to a composite. Therefore, within a composite of this type there is cohesion between the carrier material, the latent heat storage material held therein and the embedding material, in which arrangement the carrier material may be present in cohesive form or in the form of a plurality of carrier material part-bodies which are held together in the composite. By means of a corresponding composite, it is possible, in particular with an external shaping which is adapted to the individual case, to form a latent heat body, or alternatively a latent heat body may also, as explained in further detail below, be formed from a number of composites of this type, which together are incorporated in a matrix material and in the sense of the invention are also referred to as conglomerates. Compared with known latent heat bodies, the composite which is achieved by the embedding therefore in

particular represents a technical advantage in use, since in the case of latent heat bodies which comprise a plurality of latent heat part-bodies, the use of an outer sheath, for example of a film or foil, for shaping and holding the bodies together can be dispensed with. A further technical advantage in use lies, as mentioned above, in the very fact that, as a result of the controlled adaptation of the material used to the carrier material, desired resultant properties of the latent heat body can be set in a controlled manner. There is preferably provision for the proportion of the embedding material in the sum of the masses of latent heat storage material, carrier material and embedding material to be at least approximately 50%, lower proportions by mass also being possible or sensible, depending on the particular use. Furthermore, it is preferable for the proportion of the latent heat storage material, based on the joint mass of latent heat storage material and carrier material, to lie between approximately 40% and approximately 80%, and preferably to be approximately 60%. The proportion of the latent heat storage material in the total weight may preferably be approximately 15% to 25%. With regard to the carrier material bodies or latent heat part-bodies, consideration is preferably given to them being of granular or fibrous structure and to a typical geometric dimension of a carrier material part-body or of a latent heat part-body being of the order of magnitude of some or a few millimeters to a few centimeters. Since, depending on the quantitative proportion added, the latent heat storage material, on account of the capillary action of the holding spaces, is situated predominantly in the interior of the carrier material or the carrier material part-bodies, in terms of the external shape and dimensions there is generally no substantial difference between carrier material part-bodies and latent heat part-bodies.

Furthermore, it is possible for the latent heat body, according to one of the variant embodiments proposed overall hitherto, to contain a number of conglomerates, which are each formed from a number of carrier material part-bodies, in which latent heat storage material is held and which together are surrounded by an embedding material, the conglomerates together being incorporated in or surrounded by a matrix material. The carrier material part-bodies which belong to an individual conglomerate, on account of the embedding material in which or by which they are embedded or surrounded together, are held together, so that, depending on the preferred number of carrier material part-bodies enclosed therein and the size of the individual carrier material part-bodies, conglomerates of different size which can be adapted to the particular use can be formed. Materials which are selected from the group consisting of silicone, in particular silicone rubber, resin, gypsum, cement and concrete are particularly suitable as matrix material, combinations of these materials possibly also being expedient. Consideration is preferably given to selecting a different material as the matrix material from that used for the embedding material. Depending on the individual properties of the carrier material selected in the individual case, the embedding material and the matrix material, it is then advantageously possible, by adapting the quantitative ratios, to achieve a desired overall property of the latent heat body; in this context the strength, hardness, elasticity, thermal conductivity, heat storage capacity and the like, for example, can be set in a controlled way as properties. In a preferred embodiment, the proportion of the matrix material in the total mass of the latent heat body may be at least approximately 50%.

In one example of use, latent heat part-bodies may be formed from in each case a shred of cardboard which is

impregnated with latent heat storage material, with a proportion by mass of, for example, 40-80%, preferably 60%, of latent heat storage material, based on the total mass of the latent heat part-body. A conglomerate may contain a number of carrier material part-bodies of this type, which together are embedded in a resin and, in the process, are enclosed by the resin, so that the carrier material part-bodies are held together. The proportion by mass of the latent heat storage material in the total mass of the conglomerate may, for example, be approximately 30%. For their part, the conglomerates described above may, for example, be added to concrete up to an approximately 50-50 mixing ratio, so that the proportion by mass of the latent heat storage material in the latent heat body formed is preferably up to approximately 15%. Variations on this example of use may consist in silicone being provided instead of the resin and/or latent heat part-bodies made from granulated siliceous earth impregnated with latent heat storage material being provided. Surprisingly, with embodiments of this type it has emerged that the structural strength of the concrete is not adversely affected, but rather under certain circumstances is even positively affected. For this, it is pertinent that the carrier material, on account of the above-described order of magnitude of the carrier material part-bodies, as a result of the capillary holding spaces exerts a pronounced sucking action on the latent heat storage material. While in contrast, for example when carrier materials in powder form are used, the latent heat storage material attached thereto would always also be directly surrounded by the embedding material and would lead to strength losses therein, this is effectively avoided by the uptake of the latent heat storage material in the carrier material part-bodies which has been explained above. A substantial advantage of a latent heat body formed from carrier material, latent heat storage material and embedding

material as well as, if appropriate, additional matrix material also consists in the fact that the granules and/or the fibers of the carrier material additionally serve as reinforcement and thus increase the static stability. The importance of the embedding material (and if appropriate the matrix material) initially consists in, before its/their crosslinking or curing, firstly establishing specific, desired free-flowing properties or easy deformability of the mix formed with the latent heat part-bodies, for processing, so that this mix can, for example, be rolled out or cast into a mold. By contrast, after the crosslinking or curing, the function involves codetermination of the resultant abovementioned overall properties of the latent heat body. All in all, the functions of support material, latent heat storage material, embedding material and matrix material are separate from one another, so that as a further advantage there are no instances of functions being exceeded. Preferred embodiments of the latent heat body according to the invention may be given, for example, in the construction industry, for example as wall, floor or ceiling panels, as road coverings, but also as items of clothing, for example as shoe soles and, moreover, for example as elastic thin-film elements or prostheses. Depending on the particular use, the proportion of paraffin-based latent heat storage material may also amount to 15% to 25% of the total weight of the latent heat body.

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The invention also relates to a method for producing a latent heat body ~~according to the precharacterizing clause of claim 57~~. In this context too, reference is made to the prior art given in WO 98/53264. Where this document describes, as a refinement of the production method, the possibility that the carrier material which has been impregnated with latent heat storage material can be divided into a number of latent heat part-bodies, the document also points out the possibility

that the latent heat part-bodies of the latent heat body may be enclosed by a sheath which encloses them together, for example a film or foil which surrounds the outer contour of the latent heat body. A latent heat body which has been manufactured accordingly in accordance with WO 98/53264 then has a number of latent heat part-bodies in its interior, which more or less loosely butt against one another and/or against the outer sheath by means of their surfaces. Working on the basis of this, the further subject matter of the present invention is based on the object of further developing a method of the generic type for producing a latent heat body so that it is advantageous for use.

This object is initially and substantially achieved wherein it is ~~with the subject matter of claim 57, in which it is~~ provided that the carrier material which has been impregnated with latent heat storage material is surrounded by an embedding material, and that a carrier material which contains wood fibers and/or cardboard and/or granulated siliceous earth and/or diatomaceous earth is used. This method has initially proven advantageous for use to the extent that a certain surface sealing of the latent heat body is achieved without the latent heat body for this purpose having to be encased by a sheath, for example a film or foil. As a further advantage it is possible, starting from the geometric shape of the carrier material impregnated with latent heat storage material, during the processing of the embedding material to achieve a possibly different desired shaping of the latent heat body, as a result of the embedding material being processed with correspondingly adapted, possibly different material thicknesses. The use according to the invention of a carrier material which contains wood fibers and/or cardboard and/or siliceous earth granules and/or diatomaceous earth results, in the desired manner, in a high capillary sucking action of the

carrier material on the latent heat storage material and, to a considerable extent also in conjunction with a preferably high specific outer area of the carrier material, in problem-free, durable attachment of the embedding material to the carrier material containing latent heat storage material in its holding spaces being achieved simultaneously. With the proposed method, it is possible to produce a latent heat body starting, for example, from an individual carrier material body, i.e. from a cohesive carrier material. A carrier material body of this type may, for example, be a shaped body which contains the carrier material mentioned above and the geometric shape of which has already been largely adapted to the shape of the desired latent heat body in a preceding working step. For example, it is possible for a shaped body of this type to be produced by adhesive bonding and/or pressing of wood fibers and/or cardboard and/or granulated siliceous earth and/or diatomaceous earth. Alternatively it is also possible, for example, for a shaped body of this type to be produced directly from a cohesive piece of cardboard or siliceous earth or diatomaceous earth. Alternatively, it is also possible for the carrier material which has been impregnated with latent heat storage material, before it is surrounded with the embedding material, to be comminuted into latent heat part-bodies, a latent heat part-body being formed from a carrier material part-body and latent heat storage material held therein as well as, if appropriate, residual air volumes which are likewise held therein. A carrier material which has been impregnated with latent heat storage material and is based on the carrier materials described above may be used as starting material for this comminution. Comminution may be achieved, for example, by pulping, chopping or cutting, but not by pulverizing down to a powder form. Then, in a further method step, a number of latent heat part-bodies which are provided for the

latent heat body may together be surrounded by the embedding material. With regard to the geometric size ratios of the latent heat part-bodies, it is pertinent that these are under no circumstances comminuted down to the size of powder grains, but rather that the comminution leads to an order of magnitude in which the sucking ability of the carrier material is maintained. With regard to the embedding material, it is generally preferred for this material, while the carrier material which has been impregnated with latent heat storage material is being surrounded therewith, to be processed into a free-flowing and/or kneadable state or to be kept in such a state. The processing may preferably involve a mixing process, mixing of the latent heat part-bodies with the embedding material, for example by stirring and/or kneading-in, being possible. Furthermore, it is preferred for the embedding material, after the carrier material which has been impregnated with latent heat storage material has been surrounded by the embedding material, to be solidified. This may preferably be carried out by a drying process, for example with thermal energy being supplied. Furthermore, it is also possible to bring about a controlled setting or curing of the embedding material by physical and/or chemical processes. In a preferred variant of the proposed process, it is provided that the latent heat body, before the embedding material solidifies, is cast into a mold, so that a latent heat body of corresponding shape is obtained after the subsequent solidification of the embedding material. As an alternative or in combination, it is possible for the latent heat body, before solidification of the embedding material is brought about, to be rolled out, so that, for example, elastic thin-film elements can be obtained.

The described method for producing a latent heat body can also be modified in such a manner that a

conglomerate is formed from a number of carrier material part-bodies with latent heat storage material held therein by a common surrounding or embedding of the corresponding latent heat part-bodies in the embedding material, and that a number of conglomerates together is incorporated in a matrix material, conglomerates in the sense of the invention being understood as meaning assemblies of the type explained above. In this context it is possible in principle for the materials which have already been proposed as embedding material also to be used as matrix material. The procedure may expediently be such that, after the processing of the embedding material and shaping of a conglomerate which is desirable under certain circumstances, firstly solidification of the embedding material is brought about, and that in a subsequent working step a number of conglomerates together is incorporated in the matrix material. In this case it is again preferable for the matrix material to be processed in a free-flowing and/or kneadable form, while in subsequent method steps initially shaping of the latent heat body and subsequent solidification of the matrix material may take place. In a preferred variant of the proposed method, the procedure is such that different materials are used as embedding material and as matrix material. As a result, depending on their physical and chemical properties, which are generally likewise different, it is possible, taking into account the physical and chemical properties of the carrier material and of the latent heat storage material, by controlled adaptation of the respective quantitative proportions, to produce latent heat bodies which have a tailored overall behavior in terms of the important properties. For example, in a latent heat body the method according to the invention allows the hardness to be continuously adjusted. By way of example, to produce a latent heat body from carrier material, latent heat storage material and embedding material,

the procedure may be such that small, relatively hard balls of paraffin-impregnated diatomaceous earth are worked into rubber-soft silicone which crosslinks at room temperature, as embedding material, so that all in all a flexible overall structure is obtained. As another extreme, it is possible, for example, for paraffin-containing, soft PAP fibers, i.e. wood fibers with a high sucking capacity for latent heat storage material, to be worked into concrete as embedding material, resulting in a storage body which is overall as hard as concrete. The production method described in the different variants also proves advantageous for use in particular because on the one hand practically any desired shaping of the latent heat body is possible prior to the solidification of the embedding material and/or the matrix material, on account of the good flow and/or kneading properties, and on the other hand the selected shape is retained, after the solidification of embedding and/or matrix material, even when the latent heat storage material is liquefied as a result of heat being supplied when the latent heat body is in use. In this case, when using the method it is generally preferred for the carrier material which is impregnated with latent heat storage material to be enclosed completely or on all sides by the embedding material. It is correspondingly preferred that, when using a matrix material, the conglomerates are enclosed therein completely or on all sides. In addition, during first initialization (initial heating) of the latent heat body, paraffin residues on the outside can be melted down and contribute to sealing of the embedding material or the matrix material.

Furthermore, the method described ~~with reference to the preceding claims 29 to 39~~, for producing a latent heat body, can also be refined in such a manner that the carrier material which has been impregnated with latent heat storage material is surrounded by an embedding

material. In a manner analogous to the foregoing constructions, in this case the carrier material which has been impregnated with latent heat storage material can be comminuted to form latent heat part-bodies, a latent heat part-body containing a carrier material part-body and latent heat storage material held therein as well as, if appropriate, air volumes. The latent heat part-bodies obtained can then together be surrounded by an embedding material. Starting from the method referred to here as well, it is possible to produce a latent heat body simply by the embedding of carrier material impregnated with latent heat storage material in the embedding material in combination with a desired shaping and subsequent solidification of the embedding material. However, this method can also be widened to the extent that, as explained above, initially conglomerates in the sense of the present patent application are produced from latent heat part-bodies and the embedding material, and these conglomerates are surrounded with a matrix material in a subsequent method step, with the result that finally the latent heat body is obtained. In this respect, for further details reference is made to the above constructions. An advantage of the proposed method using embedding material and, if appropriate, matrix material is in particular also that with this method latent heat bodies can be produced without static losses and without emulsifiers, without any problems.

a

Brief Description of The Drawings

The invention is explained in further detail below with reference to appended drawings which, however, only represent exemplary embodiments. In the drawings:

Fig. 1 shows a perspective view of a slab-like construction element with integrated latent heat body;

Fig. 2 shows an excerpt enlargement of the latent heat body in accordance with Fig. 1, with a first carrier material;

Fig. 3 shows an excerpt enlargement of the latent heat body based on Fig. 1, with a second carrier material;

Fig. 4 shows a perspective view, cut open, of an electric floor heating system with latent heat bodies integrated therein;

Fig. 5 shows an excerpt enlargement of a latent heat body in accordance with Fig. 4 formed from latent heat part-bodies;

Fig. 6 shows a perspective view of a warming plate for food in a first embodiment;

Fig. 7 shows a sectional view of a warming plate for food in accordance with Fig. 6;

Fig. 8 shows a perspective view of a warming plate for food in a second embodiment;

Fig. 9 shows a sectional view of a warming plate in accordance with Fig. 8;

Fig. 10 shows a horizontal section through a transport container with latent heat bodies integrated therein;

Fig. 11 shows a perspective view of a latent heat body according to the invention with embedding material;

Fig. 12 shows an enlarged partial section of the latent heat body in accordance with Fig. 11, along section line XII-XII;

Fig. 13 shows a partial section of a latent heat body with embedding material and matrix material;

Fig. 14 shows a latent heat body with embedding material in the form of a sole of a shoe;

Fig. 15 shows an enlarged partial section of the latent heat body in accordance with Fig. 14 along section line XV-XV.

a Detailed Description of the Preferred Embodiments

A slab-like construction element 1, which is substantially formed from a latent heat body 2 according to the invention, which in this case is likewise in slab form, is illustrated and described, initially with reference to Fig. 1. In detail, the latent heat body 2 illustrated is a gypsum slab which has been impregnated with latent heat storage material. On a first surface, which extends in the slab plane, the latent heat body 2 is provided with a covering 3 made from a sheet material, in the present case from paper. In the installed condition of the construction element 1, that surface of the latent heat body which is provided with the covering 3 faces toward a room which the construction element 1 is used to delimit or line. The opposite surface of the latent heat body 2 bears a weather protection 4, which likewise covers the entire surface and is likewise produced from a sheet material. The respective connection between the latent heat body 2 and the covering 3 or the weather protection 4 is achieved in a conventional way using an adhesive introduced into the respective contact plane. As an alternative or in combination, it is possible for the covering 3 and the weather protection 4 to be fixed to the latent heat body 1 by suitable joining means,

such as for example staples, rivets or the like, and for the covering 3 and/or the weather protection 4 to be produced from other expedient materials, for example from metal foil.

Fig. 2 shows an excerpt enlargement of the latent heat body 2 from Fig. 1. According to this figure, the latent heat body 2 comprises a carrier material 5, which in the embodiment shown consists of a mineral substance with an open capillary pore structure, and in the specific embodiment consists of a gypsum material, and is formed as a cohesive structure. Inside the carrier material 5 there are capillary holding spaces 6 for latent heat storage material 7, which in the example of Fig. 2 are formed by the open capillary pore structure 8 of the gypsum material or are caused by this structure. It can be seen from the highly simplified and therefore only diagrammatic illustration that the open capillary pore structure 8 has channels 9 with widenings 10 which together extend in the manner of a labyrinth through the carrier material 5. Both the channels 9 and the widenings 10 are dimensioned in such a way that they exert a capillary action on liquefied latent heat storage material and to this extent represent capillary holding spaces 6 for the latent heat storage material 7. The result of this is that previously liquefied latent heat storage material, during the production of the latent heat body 2, is taken up from the adjoining environment, by the sucking action, initially by holding spaces 6 which are close to the surface and, from there, as a result of the sucking action of adjacent holding spaces 6, passes progressively into the interior of the latent heat body 2, a desired quantity of latent heat storage material 7 continuing to flow into the holding spaces 6 which are close to the edge, on account of their connections to the environment. To this extent, Fig. 2 describes an equilibrium state, in which the latent heat storage

material 7 is present distributed uniformly over the capillary holding spaces 6. In this case, the distribution of the holding spaces 6 illustrated in one plane also describes their qualitative distribution in the further spatial directions. As indicated by the respective area relationships, the proportion by mass of the latent heat storage material 7, based on the total mass of the latent heat body 2, in the example described in Fig. 2 is thus approximately 25%. It is shown in further detail that the holding spaces 6 are not completely filled with latent heat storage material 7, but rather residual air volumes 11 remain therein which, in the example shown, are likewise uniformly distributed. The residual air volumes 11 are dimensioned in such a way that they absorb a temperature-dependent change in volume of the latent heat storage material 7 in the capillary holding spaces 6 of at most 10% of the latent heat storage material volume. In Fig. 1, the channels 9 are only diagrammatically indicated by simple lines.

Based on Fig. 1, Fig. 3 shows an excerpt enlargement of a latent heat body 2′, which differs from the latent heat body 2 shown in Fig. 2 only through fiber elements 12 which are additionally present in the carrier material 5. To this extent, corresponding constituents of the latent heat bodies 2, 2′ in Figs. 2 and 3 are labeled with identical reference symbols. It can been inferred from Fig. 3, which is likewise diagrammatic, that the fiber elements 12 are of elongate and irregular form and, with an irregular spatial orientation, are disposed distributed approximately uniformly inside the carrier material 5. Furthermore, it becomes clear that in Fig. 3 the capillary holding spaces 6 are not exclusively formed by the open capillary pore structure 8 of the mineral gypsum material, but rather the fiber elements 12 are in part a constituent of the edge of the channels 9 and the

widenings 10. Furthermore, there is the possibility - not shown in the drawing in Fig. 3 - that in addition capillary holding spaces 6 are completely bordered by fiber elements 12.

In a perspective partial view, partially cut open, Fig. 4 shows an electric floor heating system 13 which is disposed on a bare floor 14 made from concrete and which has an upper covering 15 made from a material which is customary for this purpose, for example from dry screed and a floor covering which may have been laid above it. Between the bare floor 14 and the covering 15, heating registers 16 are provided, which are diagrammatically illustrated and in the present case are electric heating registers in a construction form which is conventional for this purpose. Firstly, a slab-like latent heat body 17, which in terms of its constituents and its structural internal disposition and distribution corresponds to the structure represented in Fig. 2 in an excerpt enlargement, is disposed between the bare floor 14 and the heating register 16. Moving away from the exemplary embodiment shown in Fig. 4, it is also possible for a thermal insulation layer, for example a layer of Styropor, to be provided immediately above the bare floor 14. In the arrangement shown in Fig. 4, a first layer 18 with a latent heat body 20 formed from granular latent heat part-bodies 19 is situated between the slab-like latent heat body 17 and the heating register 16. The first layer 18 is to this extent a bed of latent heat part-bodies 19 which are supported against one another, are present in granule form and together form the latent heat body 20.

As emerges in further detail from Fig. 5, an individual latent heat part-body 19 contains a carrier material part-body 21 and the latent heat storage material 7' which is present in the capillary holding spaces 6

contained therein, as well as the residual air volume 11 which is likewise contained therein. It follows from this that a latent heat part-body 19, in its interior, forms a cohesive structure with an open capillary pore structure 8, while the latent heat body 20 as a whole does not have a correspondingly cohesive structure. Rather, in its interior it has spaces 22 between the latent heat part-bodies 19, which spaces, depending on the shape and size, may likewise exert a capillary sucking action on the liquefied latent heat storage material. Although this is not illustrated in the drawing in Fig. 5, it is thus possible for latent heat storage material 7, in an equilibrium state, also to be situated in the spaces 22 and thus to make an additional contribution to holding the latent heat part-bodies 19 together. In the exemplary embodiment shown in Figures 4 and 5, it is provided that the latent heat storage material 7 held in the holding spaces 6 of the latent heat part-bodies 19 has a phase transition temperature of 52°C.

Furthermore, a second layer 23 with a latent heat body 25 formed from latent heat part-bodies 24 is disposed between the heating register 16 and the covering 15. The second layer 23 differs from the first layer 18 only through the nature of the latent heat storage material 7″ held in the respective capillary holding spaces 6. While a latent heat storage material 7′ with a phase transition temperature of 52°C is held in the first layer 18, as stated, a different latent heat storage material 7″ with a different phase transition temperature, which in the present case is 42°C and is therefore lower, is held in the second layer 23. In principle, in this case it is also possible to provide other phase transition temperatures.

In a perspective view, Fig. 6 shows a first embodiment of a warming plate 26 for foodstuffs, in particular for

rice. The warming plate 26 has a plate base body 27 with two receptacles 28 for foodstuffs 29 formed thereon. In this case, it is provided that the plate base body 27 contains a latent heat body 30 according to the invention. In the example shown, the plate base body 27 even consists entirely of the latent heat body 30, which is of a corresponding shape.

As indicated in the associated sectional view in Fig. 7 by the diagrammatic representation of the plate base body 27, the internal structure of the latent heat body 30 corresponds to the structure diagrammatically illustrated in Fig. 2. To this extent, the latent heat body 30 also has a carrier material 5 made from a gypsum material and capillary holding spaces 6 contained therein. In detail, these holding spaces are channels 9 and widening 10, which together form an open capillary pore structure 8. In connection with the warming plate 26 as well, it is proposed that the latent heat body 30 contains a proportion by mass of approximately 25% latent heat storage material, based on the total mass of the latent heat body 30, and that residual air volumes 11, which are distributed uniformly over the capillary holding spaces 6, absorb temperature-dependent changes in volume of the latent heat storage material 7 of at most 10% of the latent heat storage material volume. With regard to the structural configuration, it is proposed that the two receptacles 28 each have a recess 32 which is integrated into the top side 31 of the plate base body 27. The use of a warming plate 26 of this type may take place in such a manner that it is initially preheated, in an oven which is not shown in the drawing, to a temperature which is above the phase transition temperature of the latent heat storage material 7, uniform heating through the plate base body 27 being desirable with a view to optimal utilization of the heat storage capacity. After the heating operation has

ended, the warming plate 26 can be taken out of the oven and a container, for example - as shown in Figures 6 and 7 - a pan 33, in the interior of which are situated foodstuffs 29 which are to be kept warm and are not shown in more detail, can be introduced into the receptacles 28. Provided that or as soon as the pan 33 has a lower outside temperature than the surface of the warming plate 26, heat transfer takes place from the warming plate 26 to the pan 33 and, from there, to the foodstuffs 29 contained therein, in the example shown in Figures 6 and 7 specifically rice, which is not shown in the drawing. As can be seen clearly in particular from Fig. 7, the recesses 28, in terms of their dimensions, are adapted to the shape of the pan 33 in such a manner that there is direct mutual contact both at the bottom 34 and at the side walls 35. Consequently, large-area and virtually unimpeded heat transfer can take place preferably through thermal conduction. To make it easier to insert the pan 33 into a recess 28, an encircling rounded-off portion 36 in terms of the cross section is provided along the upper edge of the recesses 28. Since in accordance with the exemplary embodiment shown in Figures 6 and 7, the foodstuffs are situated in the interior of a separate pan 33 and are therefore only brought into indirect contact with the warming plate 26, the warming plate can also be of particularly simple form including from hygiene points of view. In particular, it is possible to dispense altogether with an outer sheath, since, on account of the inventive structure of the latent heat body 30, there is also no risk of the latent heat storage material sweating out, at least when the phase transition temperature of the latent heat storage material 7 is exceeded by from 30 to 40°K.

Figures 8 and 9 relate to a second embodiment of a warming plate 37 for foodstuffs 29, in particular for rice. The warming plate 37 has a plate base body 38

which contains a latent heat body 39. The latent heat body 39, in terms of its constituents and its internal structure, does not differ from the latent heat body 30 illustrated in Figures 6 and 7. However, there are differences in terms of the external shape and in that the latent heat body 39 is enclosed by a sheath 40 which is impermeable to latent heat storage material 7 and in the specific example is formed from a metal foil with good thermal conductivity. In detail, the sheath 40 has a bottom part 41 and a top part 42, which in the region of a common encircling overlap 43 are joined to one another by a layer of adhesive 44. The substantial difference compared to the first embodiment of a warming plate shown in Figures 6 and 7 therefore consists in the fact that the foodstuffs 29, or the rice, after the warming plate 37 has been heated in an oven, are introduced directly into the receptacles 28 integrated into the top side 31, so that there is no need for an additional container. The sheath 40 on the one hand separates the foodstuffs 29 from the latent heat body 39 and on the other hand allows easy cleaning of the warming plate 37 without the risk of damage.

In a horizontal section, Fig. 10 shows a transport container 45 with an outer housing 46 and an inner housing 47 which is held therein, spaced apart by a space. The outer housing 46 is additionally lined with a thermal insulation 48, in the present case with a layer of Styropor. In this case, it is provided that latent heat bodies 49, 50 are disposed in the remaining space. In the example shown, the latent heat bodies 40, 50 are each of plate-like form, the plate plane extending perpendicular to the plane of the drawing. In the specific example, four pairs of in each case one latent heat body 49 and one latent heat body 50, which are in contact with one another in a surface-parallel manner, are formed, the pairs in the space between the inner housing 47 and the outer housing 46 or the

thermal insulation 48 being disposed in offset manner with respect to one another. The latent heat bodies 49 each adjoin the inner housing 47, while the latent heat bodies 50 each face the outer housing 46. Furthermore, it is provided that respectively adjacent end faces 51, 52 of the latent heat bodies 49, 50 bear against surface regions 53 of an adjacent latent heat body 49 which project beyond the inner housing 47, so that there are no continuous cavities between the pairs of latent heat bodies. In the exemplary embodiment shown, the latent heat bodies 49, 50 have in principle the same constituents and the same internal structure as the latent heat body 2 illustrated in Fig. 2. Differences may exist only in terms of the phase transition temperatures of the respective latent heat storage materials 54, 55, so that an optimum storage action can be established as a function of the ambient temperature of the outer housing 46 and the desired temperature in the interior 56 of the inner housing 47, by means of a multistage store. Furthermore, the transport container 45 has a base (not shown) and a lid which can pivot, for example by means of hinges, a composite structure comprising a thermal insulation and latent heat bodies expediently also being provided in the base and lid regions. The transport container 45 illustrated is used to transport a material 57 which is held in the interior 56 and is to maintain a temperature which is as constant as possible during transport. If the temperature of the material 57 is to be above the ambient temperature, the latent heat bodies 49, 50 may be heated in an oven prior to transport and then inserted into the space between the outer and inner housing. By contrast, if the transport temperature is to be below the ambient temperature, the latent heat bodies 49, 50 can be correspondingly cooled prior to transport and then inserted into the transport container. The transport container 45 shown in Fig. 10 can therefore advantageously be used for different

purposes, latent heat bodies 49, 50 in which latent heat storage material 54, 55 with phase transition temperatures which have been specifically adapted to the actual transport conditions is held, being selected in each case.

In addition, it is pointed out that the latent heat bodies described in connection with Fig. 1 to 10 may, as an alternative to or in combination with the features described in the specific case, also have one or more of the further features which have been explained in the general part of the description.

In Fig. 11, there is shown a perspective view of a latent heat body 58 according to the invention, in which a multiplicity of latent heat part-bodies 59, which are initially illustrated in simplified form, are surrounded by a common embedding material 60. As can be seen in further detail from the enlarged sectional view in Fig. 12, each of the latent heat part-bodies 59 has a carrier material part-body 61, which in the example shown is a granular grain of diatomaceous earth. The carrier material part-body 61 is of an order of magnitude at which a multiplicity of capillary holding spaces 62 are situated in its interior; in practice, the number of capillary holding spaces in a carrier material part-body may be considerably higher than can be shown in the greatly simplified illustration. This correspondingly applies to the size of the individual capillary holding spaces 62, which in reality may be much smaller than the size illustrated in Fig. 12. In further detail, it can be seen that latent heat storage material 63 is held in each case inside individual capillary holding spaces 62, while maintaining residual air volumes 64. In the exemplary embodiment shown, the capillary holding spaces 62 inside the carrier material part-bodies 61 form a labyrinth-like structure in which the paraffin-based latent heat storage material 63 is

held. The individual latent heat part-bodies 59 together are surrounded by the embedding material 60, which in the example shown is concrete. As a result of the embedding material 60, a permanent cohesion is produced between the carrier material part-bodies, and this is retained even when the latent heat storage material is liquefied. The plate form of the latent heat body 58 which is expressed in Figure 11, during production, was achieved by the fact that the mix formed from the latent heat part-bodies 59 and the embedding material 60, in an overall state in which it still flowed freely, i.e. before the concrete set, was poured into a corresponding mold. It can also be seen from Fig. 12 that the proportion of the embedding material 60 in the total mass of the latent heat body 58 is approximately 50%.

In Fig. 13, in a partial section there is a description of a latent heat body 65 which has been modified compared to Figures 11 and 12 to the extent that the individual latent heat part-bodies 59 therein are initially surrounded, in each case in smaller numbers, by an embedding material 66, in the example illustrated by silicone. This predominantly leads to the formation of conglomerates 67 which each comprise a plurality of latent heat part-bodies 59 which together are surrounded by the embedding material 66. In the example shown, as a result of the use of silicone as embedding material 66, after crosslinking thereof, a permanent and, within certain limits, resilient or elastic cohesion between the latent heat part-bodies 59 of a conglomerate 67 is achieved in the use state. It is obvious that in practice the number of latent heat part-bodies 59 per conglomerate 67 may vary considerably and in particular may also considerably exceed the numbers shown in the simplified illustration. However, as is likewise shown, it is also possible for individual latent heat part-bodies on

their own to be surrounded by the embedding material 66. It is also shown in Fig. 13 that the conglomerates 67 together are surrounded by a matrix material 68, which in the exemplary embodiment is concrete. The matrix material 68 correspondingly produces cohesion between the conglomerates 67, so that the latent heat body 56 shown in Fig. 13 externally may not differ or may only differ unsubstantially from the latent heat body 58 shown in Figures 11 and 12.

A further exemplary embodiment of a latent heat body 69 according to the invention, in the form of a sole of a shoe, is illustrated in Fig. 14. Using the reference symbols which have already been used in connection with Figures 11 and 12, the latent heat body 69 has an embedding material 60 which, however, in the example described here is silicone. A multiplicity of latent heat part-bodies 59 are surrounded by the embedding material 60, the proportion by mass of the silicone in the total mass of the latent heat body 69 being approximately 50%. The silicone used as embedding material 60 provides a permanent cohesion between the latent heat part-bodies 59, the latent heat body 69 overall having a high resilience and therefore easy deformability and good comfort properties in use.

As emerges in connection with the enlarged partial section of the latent heat body 69 shown in Figure 15, the latent heat part-bodies 59 contained therein are shreds of cardboard with paraffin-based latent heat storage material 63 held in capillary holding spaces 62 therein. It can also be seen that a residual air volume 64 is also formed in the capillary holding spaces 62. The carrier material part-body, i.e. the cardboard shred, contained in the latent heat part-body 59 in accordance with Fig. 14 has a multiplicity of fibers 70, which are illustrated in simplified form, of wood or cellulose which are held together by a binder which

is customary in the production of cardboard. Moreover, capillary holding spaces 62, in which the paraffin-based latent heat storage material 63 and the residual air volumes 64 are held, are formed between the fibers 70 in the interior of the carrier material part-body 61 in the example of the cardboard shred. Although this cannot be seen from the illustration, the capillary holding spaces may preferably be connected to one another. The cardboard shreds, which in the example illustrated are elongate, may be formed by prior comminution of cardboard, for example by tearing or cutting, while other geometries, for example round platelets approximately in the shape of a relatively small coin, can be used instead of the elongate shape. On the other hand, the carrier material part-bodies may also have a filament-like form and may be slightly thicker than hairs. It is pertinent that the carrier material is only comminuted sufficiently far or only has a sufficient dimension for the capillary holding spaces 62 to be retained therein, so that a good suction capacity of the carrier material with regard to the latent heat storage material 63 is ensured.

All the features disclosed are pertinent to the invention. The content of the disclosure of the associated/appended priority documents (copy of the prior application) and the contents of the documents PCT/EP 98/01956, DE 198 36 048.7, DE-A 43 07 065 are hereby also fully incorporated into the disclosure of the present application, partly for the purpose of incorporating features of these documents in claims of the present application.